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(Part-III: Mineral Reviews)

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GARNET

(FINAL RELEASE)

**GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES**

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13 Garnet

Garnet is the collective name for a group of minerals which crystallise in cubic system with different chemical composition. The principal members of the Garnet group are Almandine (Fe-Al), Pyrope (Mg-Al), Spessartite (Mn-Al), Grossularite (Ca-Al), Andradite (Ca-Fe) and Uvarovite (Ca-Cr). Almandine is hardest amongst all varieties and is often used for abrasive purpose. Garnet is dense & hard with sharp angular chisel-edged fracture, containing small amounts of free silica and exhibits high resistance to physical and chemical attacks. It is used both as semi-precious stone and as an abrasive. The hardness of garnet varies from 6.5 to 7.5 on Mohs scale. This allows it to be used as an effective abrasive.

RESERVES / RESOURCES

In India, garnet deposits suitable for use in Abrasive Industry occur in Andhra Pradesh, Chhattisgarh, Jharkhand, Kerala, Odisha, Rajasthan, Tamil Nadu and Telangana. Gem variety of garnet occurs in Ajmer, Bhilwara, Jhunjhunu, Sikar and Tonk districts, Rajasthan; Nellore and Srikakulam districts, Andhra Pradesh; Khammam district, Telangana and Coimbatore, Ramanathapuram, Tirunelveli, Kanyakumari, Tiruchirappalli and Tiruvarur districts, Tamil Nadu. Garnet is found to occur in beach sands along with ilmenite, rutile, sillimanite, etc. in the States of Kerala, Odisha and Tamil Nadu.

The total reserves/resources of garnet in India as on 1.4.2015, as per UNFC system has been placed at 56.16 million tonnes of which Reserves under Proved and Probable categories together constituted 12.78 million tonnes. Of the total resources, about 20.90 million tonnes are of Abrasive grade, whereas resources of Semi-precious grade are mere 5,803 tonnes only. Tamil Nadu alone accounted for about 48% of the total resources followed by Andhra

Pradesh (31%), Odisha (17%) and Telangana (3%). The remaining states together shared less than 1% (Table- 1).

EXPLORATION & DEVELOPMENT

The details about the exploration and development, if any, are covered in the Review on “Exploration and Development” under “General Reviews”.

PRODUCTION, STOCKS AND PRICES

Garnet (Abrasive)

Production of garnet (abrasive) at 1,23,404 tonnes during 2018-19 decreased by 22% as compared to that in the preceding year. There were 9 reporting mines during 2018-19 as against 7 mines reported in the year 2017-18. Besides, production of garnet (abrasive) was also reported as an associated mineral by one sillimanite mine in Odisha. Three principal producers accounted for about 96% of the total output during the year. The share of Public Sector in the total output was about 37% in 2018-19 as opposed to 26% in the previous year. Similarly the share of Private Sector in the total output was 63% in 2018-19 as opposed to 74% in the preceding year.

In 2018-19, 59% of the total production was reported from Andhra Pradesh, 31% from Odisha, 6% from Tamil Nadu and 4% was from Rajasthan State (Tables-2 to 4).

Mine-head closing stocks of garnet (abrasive) for the year 2018-19 were 96 thousand tonnes as against 78 thousand tonnes in the previous year (Table -5).

The average daily employment of labour during 2018-19 was 1,126 as against 863 in the previous year.

Table – 1 : Reserves/Resources of Garnet as on 1.4.2015
(By Grades/States)

Grade/State	Reserves				Remaining Resources				Total Resources (A+B)				
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331		Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)
		STD121	STD122			STD221	STD222						
All India : Total	9917936	278493	2587427	12783856	84320	1643412	3287667	121099	10247428	27992906	333	43377166	56161022
By Grades													
Gem	39000	362	34	39396	2	81339	-	-	-	109	-	81450	120846
Abrasive	9804483	276468	2586266	12667217	3062	1489600	3194708	106060	19428	3423374	333	8236565	20903782
Semi-precious	18	13	1128	1159	41	115	514	39	1249	2688	-	4645	5803
Others	-	-	-	-	9051	36358	-	-	-	215573	-	260982	260982
Unclassified	74435	1650	-	76085	72164	36000	394	15000	10225996	23968842	-	34318396	34394481
Not-known	-	-	-	-	-	-	92051	-	756	382321	-	475128	475128
By States													
Andhra Pradesh	1183898	4500	568750	1757148	12189	232525	791238	18	8800000	5674011	-	15509981	17267129
Chhattisgarh	-	-	-	-	-	-	-	-	-	28800	-	28800	28800
Jharkhand	-	-	-	-	-	-	88303	-	-	21768	-	110071	110071
Kerala	-	-	45797	45797	-	-	-	100874	-	52190	-	153064	198861
Odisha	8459821	-	585130	9044951	5	-	-	-	-	348000	-	348005	9392956
Rajasthan	33566	35926	5556	75048	3100	26663	29629	5207	21432	123587	333	209952	285000
Tamil Nadu	225554	238067	1382194	1845815	21936	1342191	2378497	15000	1425996	19888574	-	25072194	26918009
Telangana	15097	-	-	15097	47090	42033	-	-	-	1855976	-	1945099	1960196

Figures rounded off

Table – 2 : Principal Producers of Garnet (Abrasive), 2018-19

Name & address of producer	Location of mine	
	State	District
Indian Rare Earths Ltd, Plot No. 1207, Veer Savarkar Marg, Near Siddhivinayak Temple, Prabhadevi, Dadar- 400 028, Mumbai, Maharashtra.	Tamil Nadu Odisha	Kanyakumari Ganjam*
Transworld Garnet India Pvt. Ltd, New No. 34, Old No. 46, M.G.R. Road, Kalakshetra Colony, Besant Nagar, Chennai- 600 090, Tamil Nadu.	Andhra Pradesh	Srikakulam
Trimex Sands Pvt. Ltd, Trimex Towers, No. 1, Subbraya Avenue, C.P. Ramaswamy Road, Alwarpet, Chennai-600 018, Tamil Nadu.	Andhra Pradesh	Srikakulam

*producing as an associated mineral with sillimanite

**Table – 3 : Production of Garnet (Abrasive) 2016-17 to 2018-19
(By States)**

(Qty in tonnes; Value in `000)

State	2016-17		2017-18		2018-19 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	85413	787302	158277	1618903	123404	1568237
Andhra Pradesh	51243	565747	111513	1283793	72521	1031030
Odisha	22076	133979	34170	242504	38376	393288
Rajasthan	1482	2567	5781	18717	5166	34718
Tamil Nadu	10612	85009	6813	73889	7341	109201

**Table – 4 : Production of Garnet (Abrasive), 2017-18 & 2018-19
(By Sectors/States/Districts)**

(Qty in tonnes; Value in `000)

State/District	2017-18			2018-19 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	7(1)	158277	1618903	9(1)	123404	1568237
Public sector	1(1)	40983	316393	2(1)	45717	502489
Private sector	6	117294	1302510	7	77687	1065748
Andhra Pradesh	2	111513	1283793	2	72521	1031030
Srikakulam	2	111513	1283793	2	72521	1031030
Odisha	(1)	34170	242504	(1)	38376	393288
Ganjam	(1)	34170	242504	(1)	38376	393288
Rajasthan	2	5781	18717	3	5166	34718
Ajmer	-	-	-	1	18	54
Bhilwara	2	5781	18717	2	5148	34664
Tamil Nadu	3	6813	73889	4	7341	109201
Kanyakumari	1	6813	73889	2	7341	109201
Tiruchirappalli	2	-	-	2	-	-

Figures in parentheses indicate associated mine of sillimanite

Table – 5 : Mine-head Closing Stocks of Garnet (Abrasive) 2017-18 & 2018-19 (By States)

(In tonnes)		
State	2017-18	2018-19 (P)
India	78008	96442
Andhra Pradesh	10429	22026
Odisha	2864	3790
Rajasthan	1704	3829
Tamil Nadu	63011	66797

Garnet (Gem)

No production of garnet (gem) was reported during 2018-19.

MINING & MARKETING

Garnet is obtained generally by digging small shallow pits barring a few places in Tamil Nadu where it is recovered from sea shore. Mining is done manually with the help of pick axes and spades. Drilling and blasting are not required as garnet is excavated from soft weathered rocks. Fine abrasive garnet is recovered from processing of beach sands. The mining of beach sand is done by dry and wet dredging. In Heavy Upgradation Plant and Mineral Separation Plant, individual minerals including garnet are separated. Sands with 26% of contained garnet is upgraded to 80-88% garnet-rich concentrate at TGI Plan, which is further upgraded to 98-99% pure product. The combined installed capacity of garnet at IREL plants located in Odisha and Tamil Nadu is 30,000 tonnes. The production from mines is graded into two varieties—abrasive and gem, depending on the clarity of crystals. After cutting and polishing, clear, flawless and rich-colour crystals of garnet are sold as semi-precious stones.

USES & CONSUMPTION

The most important industrial use of garnet in the form of garnet sand is as an abrasive. About 90% production of abrasive garnet is used for manufacturing of garnet-coated papers, clothes

and discs. Garnet-coated abrasives are used in the form of belts, covers for drums, discs or as small sheets. It is used for cleaning spark plugs, paints, polishing and grinding of plate-glass. The remaining 10% output is used in the form of loose grains for surfacing and polishing soft stones (marble, slate, soapstone, etc.). Clear, flawless and rich-coloured crystals of garnet are used as semi-precious stones. The principal variety among them are pyrope, deep-crimson almandine, orange-yellow grossularite, etc. Other uses are in Electronic and Television Industry for polishing glass and TV tubes. Garnet granules are used in 'abrasive blasting' commonly called 'sand blasting' in order to smoothen, clean and remove oxidation products from metals, stone and other material. MMTC's specifications of garnet sand used for sand blasting/jet cutting/other uses for exports to USA, Europe, Middle East and Taiwan are as follows: Al_2O_3 : 20.8 to 21.2%, Bulk density; 2.17 kg/m³, Hardness in Mohs scale should be 7.5 to 8.

Water jet cutting machines generally use finely-ground 80-120 mesh size garnet as cutting medium with high pressure water. Owing to its inertness to a wide range of chemicals and relatively high specific gravity, it is used as filter medium for water and other liquids.

SUBSTITUTES

Other natural and manufactured abrasives can substitute to some extent for all major end uses of garnet. In many cases, however, using the substitutes would entail sacrifices in quality or cost. Fused aluminium oxide and staurolite compete with garnet as a sandblasting material. Ilmenite, magnetite and plastics compete as filtration media. Corundum, diamond and fused aluminium oxide compete for lens grinding and for many lapping operations. Emery is a substitute in nonskid surfaces. Fused aluminium oxide, quartz sand and silicon carbide compete for the finishing of plastics, wood furniture and other products.

WORLD REVIEW

Garnet group of minerals are found throughout the world in metamorphic, igneous and sedimentary rocks.

World resources of garnet are large and occur in a wide variety of rocks, particularly gneisses and schists. Garnet also occurs in contact-metamorphic deposits in crystalline limestones, pegmatites, serpentinites, and vein deposits. In addition, alluvial garnet is present in many heavy-mineral sand and gravel deposits throughout the world. Large domestic resources of garnet also are concentrated in coarsely-crystalline gneiss near North Creek, NY; other significant domestic resources of garnet occur in Idaho, Maine, Montana, New Hampshire, North Carolina, and Oregon. In addition to those in the United States, major garnet deposits exist in Australia, Canada, China, India and South Africa, where they are mined for foreign and domestic markets; deposits in Russia and Turkey also have been mined in recent years, primarily for internal markets. Additional garnet resources are in Chile, Czech Republic, Pakistan, Spain, Thailand and Ukraine; small mining operations have been reported in most of these countries.

In 2019, Australia produced about 33% of total global production of garnet (Industrial), followed by China (26%), South Africa (16%), India (13%), and the remaining 12% was contributed by USA and other countries. Russia and Turkey are also mining garnet for domestic markets. Garnet is also mined in Canada, Chile, Czech Republic, Pakistan, South Africa, Spain, Thailand and Ukraine.

Worldwide the end uses of garnet and market shares are: abrasive blasting media 30%, abrasive grains for water jet cutting 35%, water filtration 20%, abrasive powder 10% and other end uses 5 per cent.

The world reserves and production of industrial garnet are furnished in Tables- 6 and 7.

Table – 6 : World Reserves of Garnet (Industrial) (By Principal Countries)

(In 000' tonnes)	
Country	Reserves
World: Total	Moderate to Large
Australia	Moderate to large
China	Moderate to large
India*	13000
South Africa	NA
USA	5000
Other countries	6500

Source: USGS Mineral Commodity Summaries, 2020

** In India as per NMI data based on UNFC system the total reserves/resources of garnet as on 1.4.2015 are estimated at 56.16 million tonnes.*

Table – 7 : World Production of Garnet (Industrial) (By Principal Countries)

(In tonnes)			
Country	2017	2018	2019
World: Total (rounded)	974000	1250000	1200000
Australia	364000	360000	400000
China	100000	290000	310000
South Africa	211000	278000	190000
India*	142000	162000	150000
USA	107000	101000	93000
Other countries	50000	60000	60000

Source: USGS, Mineral Commodity Summaries 2020,

Note : Figures are rounded off

** India's production of garnet (abrasive) during 2016-17, 2017-18 and 2018-19 was at 85 thousand tonnes, 158 thousand tonnes and 123 thousand tonnes respectively*

FOREIGN TRADE

Exports

In 2018-19, exports of abrasive garnet decreased by 34% to 1,04,343 tonnes from 1,57,223 tonnes in the previous year. Exports were mainly from USA (39%), UAE (14%), Qatar (8%), Saudi Arabia, Italy & Canada (4% each) and Malaysia (3%). Exports in terms of value in respect of cut uncut garnet variety increased marginally by 19% to ` 49.48 crore in 2018-19 from ` 41.67 crore in the previous year. In terms of value, exports were mainly from Thailand (37%), Hong Kong (35%), USA (11%), Japan (6%) and Italy (2%).

Out of the total exports in terms of value of cut & uncut garnet in 2018-19, cut variety of garnet accounted for 96% share and the remaining 4% was contributed by the uncut garnet. Exports of cut variety

were mainly from Thailand (35%), Hong Kong (29%), and USA (19%). Similarly, exports of uncut garnet were mainly from Hong Kong (97%) and the remaining 3% share was contributed by China (Tables- 8 to 11).

**Table – 8 : Exports of Garnet (Abrasive)
(By Countries)**

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	157223	2346626	104343	1783920
USA	13771	196846	40772	666775
UAE	37341	543044	14554	253700
Qatar	4579	83613	8726	158596
Saudi Arabia	7684	125878	4680	82106
Italy	10263	155572	4340	74647
Canada	7288	109452	4245	70614
Germany	9340	136237	2789	51709
Malaysia	7065	102383	3094	49410
Thailand	2661	46238	1857	30297
Australia	6542	102114	1560	30272
Other countries	50690	745251	17727	315794

Figures rounded off

**Table- 9 : Exports of Garnet (Cut & Uncut)
(By Countries)**

Country	2017-18 (R)		2018-19 (P)	
	Qty (**)	Value (` '000)	Qty (**)	Value (` '000)
All Countries	**	416710	**	494842
Thailand	**	157202	**	182991
Hong Kong	**	125170	**	172459
USA	**	62862	**	56186
Japan	**	28874	**	27813
Italy	**	13392	**	8270
Germany	**	3842	**	8174
UK	**	3814	**	8152
Czech Republic	**	7117	**	7262
Russia	**	2783	**	5847
UAE	**	491	**	3029
Other countries	**	11162	**	14659

Note : ** - Not additive. The total may not tally.

Figures rounded off

**Table – 10 : Exports of Garnet (Cut)
(By Countries)**

Country	2017-18 (R)		2018-19 (P)	
	Qty (crt)	Value (` '000)	Qty (crt)	Value (` '000)
All Countries	28087423	381868	14428334	473034
Thailand	5450484	155844	5103651	181999
Hong Kong	17734057	92441	4130048	152754
USA	2374368	62487	2803731	56143
Japan	461964	28874	570319	27808
Italy	480954	13392	340295	8268
UK	572300	3814	412427	8147
Germany	348859	3628	315726	7703
Czech Republic	61410	7117	67419	7262
Russia	81207	2783	132183	5826
UAE	16423	478	14243	3029
Other countries	505397	11010	538292	14093

Figures rounded off

**Table – 11 : Exports of Garnet (Uncut)
(By Countries)**

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	143	34842	116	21808
Hong Kong	141	32729	113	19705
Thailand	++	1359	++	992
Germany	++	214	++	471
France	-	-	++	383
China	1	62	3	131
USA	++	376	++	43
Singapore	-	-	++	26
Russia	-	-	++	21
Canada	-	-	++	18
Japan	-	-	++	5
Other countries	++	103	++	13

Figures rounded off

Imports

In 2018-19, imports of abrasive garnet decreased drastically by 81% to 422 tonnes from 2,256 tonnes in the previous year. Imports were mainly from UAE (91%), Australia (6%), and China (3%). Imports in terms of value in respect of cut & uncut garnet

variety decreased drastically by 49% to ` 16.98 crore in 2018-19 from ` 33.59 crore in the previous year. In terms of value, imports were mainly from Hong Kong (27%), Kenya (24%), Thailand (21%), Sri Lanka (8%) and USA (6%).

Out of the total imports in terms of value of cut & uncut garnet in 2018-19, uncut variety of garnet accounted for 73% share and the remaining 27% was contributed by the cut garnet. Imports of uncut variety

were mainly from Hong Kong (38%), Mozambique (23%) and Kenya (15%). Similarly, imports of cut garnet were mainly from Sri Lanka (32%), Hong Kong & China (26% each) & Thailand (11%) (Tables-12 to 15).

**Table – 12 : Imports of Garnet (Abrasive)
(By Countries)**

Country	2017-18 (P)		2018-19 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	2256	21243	422	6410
UAE	1754	14187	384	5843
China	2	50	12	428
Australia	370	5781	26	102
Madagascar	-	-	++	37
Bahrain	130	1185	-	-
South Africa	++	40	-	-

Figures rounded off

**Table- 13: Imports of Garnet (Cut & Uncut)
(By Countries)**

Country	2017-18 (P)		2018-19 (P)	
	Qty (**)	Value (` '000)	Qty (**)	Value (` '000)
All Countries	**	335897	**	169836
Hong Kong	**	112462	**	45485
Kenya	**	32718	**	40317
Thailand	**	42496	**	36026
Sri Lanka	**	12895	**	13825
USA	**	11094	**	10347
South Africa	**	21	**	7244
Madagascar	**	6151	**	3487
Tanzania	**	3535	**	2484
Zambia	**	3484	**	2268
Mozambique	**	25684	**	2149
Other countries	**	85357	**	6204

Note : ** - Not additive. The total may not tally.

Figures rounded off

**Table – 14 : Imports of Garnet (Cut)
(By Countries)**

Country	2017-18 (P)		2018-19 (P)	
	Qty (crt)	Value (` '000)	Qty (crt)	Value (` '000)
All Countries	3702131	58096	6143979	45622
Sri Lanka	1490197	12885	1947280	13815
Hong Kong	599133	13426	1572629	12035
Thailand	420211	6429	677880	8340
USA	101706	2061	274123	8295
China	427574	1074	1599460	972
Italy	1112	39	930	924
Switzerland	-	-	2146	615
Germany	18185	240	66037	284
Taiwan	12	47	58	164
Japan	12359	586	1842	90
Other countries	631642	21309	1594	88

*Figures rounded off***Table – 15 : Imports of Garnet (Uncut)
(By Countries)**

Country	2017-18 (P)		2018-19 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	13	277801	26	124214
Kenya	2	32718	4	40317
Hong Kong	3	99036	10	33450
Thailand	1	36067	1	27686
South Africa	++	21	++	7244
Madagascar	1	6151	2	3487
Tanzania	1	3535	++	2484
Zambia	2	3483	2	2268
Mozambique	1	25684	6	2149
USA	1	9033	++	2052
UAE	-	-	++	1182
Other countries	1	62073	1	1895

Figures rounded off

FUTURE OUTLOOK

Garnet has a wide range of applications, such as, in production of abrasives, sand blasting, water filtration materials, abrasive blasting media and water-jet cutting. Garnet is expected to continue replacing silica sand blasting media, owing to later's associated occupational health

risks. Moreover, garnet is safer for the environment and cheaper to dispose of after recycling. Hence the worldwide demand for garnet is expected to increase, especially for waterjet cutting and for abrasive blasting media. China and India are expected to steadily increase garnet production and will become significant garnet sources for other countries.

